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10/586,665	07/20/2006	Takashi Azuma	520.46411X00	7343

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EXAMINER	
BRUTUS, JOEL F	

ART UNIT	PAPER NUMBER
3768	

NOTIFICATION DATE	DELIVERY MODE
09/22/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/586,665	AZUMA ET AL.	
	Examiner	Art Unit	
	JOEL F. BRUTUS	3768	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 May 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *6-12* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *6-12* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *5/27/2009*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 6-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Holley et al (US Pat: 5,902,243) in view of Hunt et al (US Pat: 6,497,665).

Regarding claims 6-8, Holley et al teach FIG. 1 shows an ultrasonic imaging system 10 suitable for use with this invention. The system 10 includes a conventional ultrasound transmit beamformer 12 that supplies transmit pulses that are applied via a transmit/receive switch 14 (the switch is used as the controller to control the two different beamformers, emphasis added) to a multi-element transducer array 16. The transducer array 16 transmits ultrasound pulses into a region R of an imaging subject. The reflected ultrasound pulses from the region R are received by the transducer array 16 and applied to a conventional ultrasound receive beamformer 18 via the transmit/receive switch 14. The receive beamformer 18 supplies as an output an analytic (pre-detection) signal, preferably via a filter 20, to a line buffer 22 that is coupled to a summer 24. By means of the line buffer 22 and the summer 24, two successive ultrasound lines are added together or subtracted. The output of the

summer 24 is sent to an image processor 26 for further processing, such as signal detection and display to the user [see column 2 lines 15-35].

The summing operations described above can include summing more than two ultrasound signals and the summing may be either of like polarity to selectively suppress fundamental components or opposite polarity to selectively suppress second harmonic components. If desired, a weighted sum can be used [see column 8 lines 15-20]. The output of the filter 20 is stored in the line buffer 22 on the first pass. On the second pass, the same ultrasound line is fired, but with a phase shift of pi radians or 180 degrees with respect to the first pulse. The second pass ultrasound data is then added to the first pass ultrasound data stored in the line buffer 22 [see column 2 lines 60-67].

Holley et al teach components of the received ultrasound data arising due to linear propagation and scattering are inverted in polarity as a result of the polarity inversion of the transmit pulses. Thus, any linear components in the received ultrasound data cancel after summing. This is illustrated in FIG. 3a, where the fundamental components 40, 42 of the first and second transmit pulses have a sum 44 that is low in amplitude [see column 3 lines 5-12]. A different result is obtained for components of the received ultrasound data arising as even harmonics from non-linear scattering or propagation.

These components will have the same phase in both the first pass received ultrasound data and the second pass received ultrasound data and will thus survive the summing operation by constructive interference. This is illustrated in FIG. 3b, where the

harmonic components 46, 48 of the first and second transmit pulses create a sum 50 a relatively large amplitude [see column 3 lines 10-19].

Holley et al teach shifting the phase of the transmit pulses by phi shifts the phase of any first harmonic (fundamental) components of the received ultrasound data by the same phase shift phi, but shifts the phase of any second harmonic components of the received ultrasonic data by 2*phi (as disclosed above by Holley et al pi or 180 degrees, therefore 2 pi for 360 degrees, emphasis added). Any third harmonic components experience a 3*phi phase shift, and so on. Thus, if a phase shift of pi radians is applied between the two transmit pulses as described above, all even harmonic components of the received ultrasound data will experience a phase shift of 2*pi*n radians and will be reinforced by summing while all odd harmonic components will experience a phase shift of 2*pi*n+pi radians, and will be canceled by the summing operation [see column 3 lines 21-33].

Holley et al don't introduce microbubble contrast agent into the living body; signal indicative of spatial distribution of microbubbles.

However, Holley et al teach that the embodiments described above can be used with or without added contrast agent in both contrast and tissue harmonic imaging [see column 8 lines 27-30].

However, Hunt et al teaches contrast agent microbubbles resonate and emit harmonics of the transmitted frequency. A display configured to receive a non-linear response creates an image of the insonified contrast agent and surrounding tissue [see abstract]. The magnitude of these microbubbles harmonics depends on the magnitude

of the excitation signal pulse [see column 2 lines 20-28]; second harmonic response occurs when contrast agent under ultrasonic [see column 2 lines 3-10]; a first amplifier, an ADC, a second amplifier, a time gain control amplifier [see column 4 lines 1-10]; suppressing tissue signal responses at the fundamental frequency of a significant magnitude so that non-linear responses from a contrast image can be detected [see column 11 lines 7-12].

Therefore, one with ordinary skill in the art at the time the invention was made would have been motivated to combine these two references by introducing microbubble for contrast agent into the living body; for the purpose of increasing visualization; using contrast agent microbubbles because it can be easily detected by an ultrasound transducer, contrast agents produce non-linear responses of greater magnitude than the surrounding tissue.

An artisan would perform transmitting/receiving operation three times or greater because the multiple pulse approach described in this specification allows broader band transmit pulses and receive filters to be used than could be used in a conventional harmonic imaging system, resulting in greater overall imaging bandwidth and hence improved axial resolution.

Regarding claim 9, all other limitations are taught as set forth by the above combination. Holley et al teach a transmit/receive switch used as a sequence controller [see fig 3-4], to control transmit pulse waves having a common envelope [see fig 5-8] and figs 14-15]. Holley et al teach shifting the phase of the transmit pulses by phi shifts

the phase of any first harmonic (fundamental) components of the received ultrasound data by the same phase shift phi, but shifts the phase of any second harmonic components of the received ultrasonic data by 2*phi. Any third harmonic components experience a 3*phi phase shift, and so on. Thus, if a phase shift of pi radians is applied between the two transmit pulses as described above, all even harmonic components of the received ultrasound data will experience a phase shift of 2*pi*n radians and will be reinforced by summing while all odd harmonic components will experience a phase shift of 2*pi*n+pi radians, and will be canceled by the summing operation [see column 3 lines 21-33].

Regarding claims 10-12, all other limitations are taught as set forth by the above combination.

Holley et al don't mention transmission amplitude in the first sequence is larger than the transmission amplitude of the second sequence.

However, Holley et al teach in FIG. 3b, where the harmonic components 46, 48 of the first and second transmit pulses create a sum 50 a relatively large amplitude [see column 3 lines 10-19].

Therefore, one with ordinary skill in the art at the time the invention was made would have been motivated to modify the Holey et al reference by having the amplitude of the first larger than the amplitude of the second component because more diagnostic information are detected during the first sequence.

Response to Arguments

3. Applicant's arguments with respect to claims 6-12 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

4. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOEL F. BRUTUS whose telephone number is (571)270-3847. The examiner can normally be reached on Mon-Fri 7:30 AM to 5:00 PM (Off alternative Fri).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Long Le can be reached on (571)272-0823. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/J. F. B./
Examiner, Art Unit 3768

/Long V Le/
Supervisory Patent Examiner, Art Unit 3768